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TABLE OF CONTENTS

A Water-mite Parasitic in Fresh-water Clams. *A. G. Humes* and *H. A. Jamnback* 77

Notes on the Habits and Habitat of *Geotrupes chalybaeus* LeConte in Florida (Coleoptera). *F. N. Young* 88

Chalepus bicolor Oliv. (Coleoptera). *C. A. Frost* 92

Polyhomoa Azuma, a Synonym of *Kyidris* Brown (Hymenoptera: Formicidae). *W. S. Creighton* 93

Massachusetts Records of *Cyphoderus assimilis* Börner (Collembola). *K. A. Christiansen* 94

Some New Nearctic Collembola. *D. L. Wray* 95

Ant Larvae of the Subfamily Cerapachyinae. *G. C. Wheeler* . . 102

The Northernmost Extension of Bird Hippoboscidae in the New World (Diptera). *J. Bequaert* 113

Vespid Wasps (*Eumenes curvata*) Attracted to Smoke. *C. T. Brues* . 114

The Alessandro Focarile Collection of Carabidae (Coleoptera). *A. Focarile* 116

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NAJADICOLA INGENS (KOENIKE), A WATER-MITE PARASITIC IN FRESH-WATER CLAMS

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The distribution of *Najadicola ingens* (Koenike 1895) Piersig 1897, a hydrachnid parasite of fresh-water clams in North America, is known only from a few scattered records. Relatively few specimens have been reported up to the present. Koenike (1895) described the species from specimens found in *Anodonta fragilis* Lamarck and *Unio complanata* (Solander)[1] and sent to him by Dr. Tyrrell of Ottawa. The collection locality was given only as Canada. Wolcott (1899) collected this mite from *Anodonta fragilis* at "26" Lake, near Charlevoix, Michigan, and Intermediate Lake, Ellsworth, Michigan, from *Unio gibbosus* Barnes, *U. ligamentinus* Lamarck, and *Anodonta footiana* Lea at Grand Rapids, Michigan, and from *U. luteolus* Lamarck at Long Lake, Kalamazoo, Michigan. He examined 3500 clams representing 60 species from Michigan, Wisconsin, Nebraska, New York, Illinois, Iowa, and Pennsylvania, but found not more than 16 specimens, all from the Michigan localities just mentioned. Wolcott (1918) stated that the species is generally distributed, but did not give additional distribution records. Marshall (1929) reported 16 adults and a few nymphs in two specimens of *Anodonta* in a small lake on Bruce peninsula, near Georgian Bay, Ontario. Kelly (1899) examined 1614 clams representing 44 species from Illinois, Iowa, and Pennsylvania, but reported no *N. ingens*, although he found several species of *Atax* (now *Unionicola*). In view of the abundance indicated below of *N. ingens* in New Eng-

[1]The name *Unio* is now properly applied to certain European clams, the North American species formerly included having been placed in other genera.

land, the apparent scarcity in other parts of the United States and Canada would seem to be only because of the inattention of investigators to this species and lack of collections.

During the five months from June 14 to November 19, 1949, 3077 fresh-water clams from 74 localities in New England, Quebec, and New Brunswick, representing 14 species, were examined for *N. ingens*. The mite was found in 43 or 58% of the localities. Altogether 906 specimens of *N. ingens* were collected, comprising 494 males and 412 females. Specimens of the clam hosts, together with about 50 mites of both sexes and from each of the three hosts reported below, have been deposited in the Museum of Comparative Zoology, Harvard University. The assistance of Mr. William J. Clench of the Museum of Comparative Zoology in identifying the clams is gratefully acknowledged.

Mites were collected from clams in the following localities which are indicated on the accompanying map (Fig. 1):

Massachusetts: (1)Sampson Pond, South Carver; (2)Monponsett Pond, Halifax; (3)Unionville Pond, Holden; (4)Carbuncle Pond, Oxford; (5)Lake Chaubunagungamaug, Webster; (6) Wickaboag Pond, West Brookfield; (7)Sandy Pond, Ayer; (8) Ward Pond, Ashby; (9)Nabnassett Pond, Tyngsboro; (10) Mashpee Pond, Mashpee; (11)Buckmaster Pond, Westwood; (12)Lake Winneconnet, Taunton; (13)Quarter Mile Pond, Medford; (14)Forge Pond, Westford; (15)Bare Hill Pond, Harvard; (16)Warner's Pond, Concord; (17)Heart Pond, South Chelmsford; (18)Lake Cochichewick, North Andover; (19)Winter Pond, Winchester; (20)Lake Attitash, Amesbury; (21)Fort Pond, Lancaster; (22)Hoosicwhisick Pond, Milton; (23)Hemenway Pond, Milton.

Rhode Island: (24)Worden's Pond, South Kingston.

Vermont: (25)Island Pond, Brighton; (26)Bomoseen Lake, Castleton; (27)Lake Champlain at Sandbar State Forest Park, Milton.

New Hampshire: (28)Crystal Lake, Eaton Center; (29)Province Lake, Effingham; (30)Wash Pond, Hampstead; (31)Island Pond, Hampstead; (32)Great Pond, Kingston; (33)Angle Pond, East Hampstead; (34)Country Pond, Newton.

Maine: (35)Long Pond, at Long Pond; (36)Madawaska Lake, Stockholm; (37)stream at Ouelette; (38)Eagle Lake; (39)

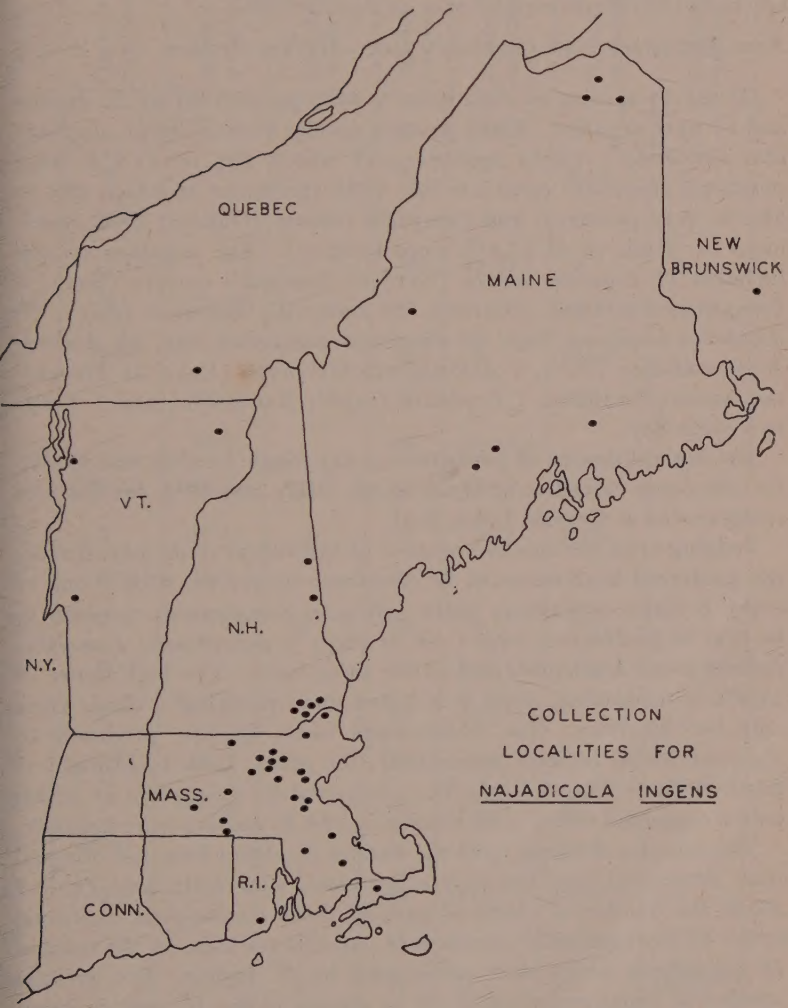

Fig. 1. Localities in New England, Quebec, and New Brunswick where *Najadicola ingens* was collected.

Park's Pond, Clifton; (40)Unity Pond, Unity; (41)China Lake, China.

Quebec: (42)Massawippi Lake, at Ayer's Cliff.

New Brunswick: (43)Cranberry Lake, Harvey Station.

Of the 14 species of clam hosts 3 were parasitized by *N. ingens* and 11 were negative. The 3 positive species were *Elliptio complanatus* (Solander) (2054 specimens of which 231 or 11.2% were positive), *Anodonta cataracta* Say (625 specimens of which 242 or 38.7% were positive), and *Lampsilis radiata* (Gmelin) (152 specimens of which 18 or 11.8% were positive). The negative species included 17 *Ligumia nasuta* (Say), 3 *Lampsilis cariosa* (Say), 3 *Lampsilis ventricosa* (Barnes), 19 *Lampsilis ochracea* (Say), 79 *Anodonta implicata* Say, 59 *Anodonta marginata* Say, 38 *Alasmidonta undulata* (Say), 1 *Alasmidonta heterodon* (Lea), 25 *Strophitus rugosus* Swainson, 1 *Leptodea fragilis* Rafinesque, and 1 *Proptera alata* Say.

The highest degree of parasitism in any single locality was 87.3% for *Anodonta cataracta* at Wash Pond, N.H., and 57% for *Elliptio complanatus* at Crystal Lake, N.H.

Judging from the relative number of individual clams parasitized, the preferred host seems to be *Anodonta cataracta,* with 1 out of every 3 clams containing mites. *Elliptio complanatus* appears to be next in preference, with 1 out of every 9 parasitized. *Lampsilis radiata* seems least preferred of the three hosts. The high figure of 11.8% is misleading, since it is based upon parasitized clams from only two localities. One, Massawippi Lake, Quebec, produced 18 clams of which 16 were parasitized; the other, Lake Champlain at Sandbar State Forest Park, Vt., comprised 23 *L. radiata* of which only 2 contained mites. The remaining 134 *L. radiata* were negative.

The samples of clams from the various localities were not of equal size. At several localities only a few clams were collected. Table I shows the number of clams of each of the 3 host species examined in the 43 localities. The numbers in parentheses indicate the number of individuals which were parasitized by *N. ingens.* The average number of clams examined of all 14 species in the 43 positive localities was 51 (1-253) and in the 31 negative localities 28 (3-134). Only 2 of the negative localities comprised more than 100 clams. Excluding these the average number of clams examined in 29 negative localities becomes 21 (3-80). These data indicate the possibil-

locality number	*Anodonta cataracta*	*Elliptio complanatus*	*Lampsilis radiata*	locality number	*Anodonta cataracta*	*Elliptio complanatus*	*Lampsilis radiata*
1		16(1)	3	23	75(27)	7	1
2	4	16(1)		24		64(6)	1
3	2(2)	4		25	6(6)	16	
4	1(1)			26	10(2)	4	4
5	8	113(12)		27		18(2)	23(1)
6	29(9)			28	9	63(36)	
7		54(7)		29		25(12)	
8		15(2)		30	142(124)		
9	25(1)	208(43)	20	31	23(21)	22(2)	
10	2	16(1)	3	32	4(1)	12(3)	
11	8(5)	32		33	2(1)	6	
12		77(8)	19	34	2	5(2)	
13	4(4)			35	13	12(1)	
14	2	80(3)	1	36	12(3)	11	
15	2(2)	18		37	3(1)	9	
16		185(7)	1	38	11(1)	11	
17	26(2)	5	2	39	22	10(1)	
18	2(2)			40	17	17(1)	12
19	1(1)			41		34(2)	1
20	19	57(19)	8	42	11	22	18(16)
21	11(8)	193(49)		43	4(4)	12	2
22		46(6)	1				

Table I. The total number of clams examined and number with *N. gens* for each of the three host species in the 43 positive localities.

ity that mites in certain localities may have been overlooked because of the small sampling.

Commonly 1 male and 1 female mite were found in each parasitized *A. cataracta* and *E. complanatus*. Single males and single females were frequently found in these clams, but very rarely two of the same sex. This was not the case in *L. radiata*, where at least two of each sex were present, one clam having 4 males and 8 females. The average number of mites per clam was 1.7 in *E. complanatus* and 1.8 in *A. cataracta*.

The smaller and presumably younger individuals of *E. complanatus* and *A. cataracta* were more frequently parasitized, as shown in Figs. 2 and 3. The arithmetical mean length for unparasitized *E. complanatus* was 6.9 cm. and for parasitized individuals 5.6 cm. The arithmetical mean length for unparasitized *A. cataracta* was 7.1 cm. and for parasitized individuals 6.2 cm. The largest parasitized clam was an *A. cataracta* 11.2 cm. in length. The smallest was an *E. complanatus* 2.7 cm. in length.

The position of *N. ingens* in the host clams varied with the host species. Almost invariably when there was a male and a female present they occurred in the same suprabranchial chamber, usually in the anterior half of the gill area. Immature mites or single males were generally located distally between the gill lamellae. The mites occurred in any of the four suprabranchial chambers, but there was noticed a distinct difference in location in *E. complanatus* and *A. cataracta*. In *A. cataracta* the mites occurred with about equal frequency in the right and left outer suprabranchial chambers. In only 4 individuals were mites found in the inner gill chambers. In *E. complanatus* the mites occurred nearly equally in the right and left inner suprabranchial chambers. In only 6 individuals were mites found in the outer gill chambers. Since mites were found in the outer chambers of *E. complanatus* and in the inner chambers of *A. cataracta*, they are probably not mechanically prevented from entering those chambers. The position of the mites seems to have little relation to the use of the gill as a marsupium, since in *A. cataracta* mites were found in both gravid and non-gravid gills. According to Baker (1928) the specialized long-term breeding clams like *Anodonta* have the gills modified to provide better water circulation than in the short-term breeders like *Elliptio*. This may have some bearing on the difference in location of the mites in the two clam genera. It is of interest to note that both these genera use the

two outer gills as marsupia. In the 17 positive *Lampsilis radiata* the mites occurred nearly equally in the four suprabranchial chambers. One clam had mites in all four of its suprabranchial chambers.

Ninety-one per cent of the parasitized clams had papillae of various sizes on the walls of the suprabranchial chambers. As many as 40 papillae were counted in one suprabranchial chamber containing a pair of mites. The largest papillae measured were 3 mm. in diameter and 5 mm. in length. Fig. 4 shows a specimen of *Anodonta cataracta* from which the left valve and mantle have been removed. The left outer suprabranchial chamber has been opened to show the papillae, a male and a female *N. ingens,* and several small, dark egg masses. In only 10 clams were papillae found without mites. Presumably these clams had previously been parasitized by *N. ingens.* The papillae were often arranged in an incomplete ring around the mites and their egg masses, perhaps acting as a barrier to prevent the eggs from being carried out of the gill chambers, either via the excurrent siphon in *Anodonta* or into the mantle cavity by way of the incomplete connection of the innermost gill lamella and visceral mass in *Elliptio.* The papillae occur mostly within the suprabranchial chambers, but in a few cases in *E. complanatus* extended down on the side of the visceral mass.

The presence of the mites apparently interferes with the use of the gills as marsupia. In many gravid, parasitized *A. cataracta* the marsupia containing mites were asymmetrically developed. The interior half of the parasitized gill contained few or no glochidia, while the unparasitized gill of the opposite side was normally developed.

The factors involved in regulating the geographical distribution of *N. ingens* are difficult to determine. The mites occurred in small ponds, large lakes, and in slowly flowing streams. All clams examined were taken from a depth of not more than 4 feet. The types of bottom included soft clay, silt, fine white sand, gravel, or small stones.

Both *N. ingens* and species of *Unionicola* were occasionally found in the same clam host. Adults of the two genera are easily differentiated, *Najadicola* being larger, cream-colored, and remaining within the suprabranchial chambers, while *Unionicola* is smaller, dark-colored, and crawling about over the surface of the gills and mantle.

The eggs of *N. ingens* are laid in masses in the suprabranchial

ELLIPTIO COMPLANATUS
PARASITIZED BY N. INGENS
NOT PARASITIZED
A.M.=ARITHMETICAL MEAN
A.M.
A.M.
NUMBER
LENGTH IN C.M.
0
10
20
30
40
50
60
70
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6

Figure 3

Fig. 2. Size of *Elliptio complanatus* indicated by length of shell valve in relation to presence of *Najadicola ingens*.

Fig. 3. Size of *Anodonta cataracta* indicated by length of shell valve in relation to presence of *Najadicola ingens*.

chambers of the clams, not inserted into the mantle or gills as in *Unionicola.* The greatest number of egg masses found in a single clam was 23 in one *A. cataracta.* Each egg mass contained approximately 250-300 eggs, and was enclosed in gelatinous material, lying unattached in the suprabranchial chamber. The color of the eggs varied from light cream when freshly laid, through orange, to nearly black when about to hatch. Masses of light cream-colored eggs were hatched in 17 days in distilled water at summer room temperature.

Sexual dimorphism is very pronounced in *N. ingens,* gravid females reaching a diameter of 5 x 6 mm., 3 or 4 times that of males. The color varies from honey yellow to light reddish brown. Microscopically the sexes may be recognized by the position of the pair of triangular genital plates. Those of the male are contiguous medially, while in the female the two plates are separated. The average number of acetabula per plate in 10 males was 72 (39-142) and in 10 females 94 (59-122). The two acetabula located near the outer apex of the plate are larger than the others.

Adult *N. ingens* can survive for several weeks at least outside the clam host. In distilled water at summer room temperature a male survived 36 days and a female 49 days. The female laid eggs during this period.

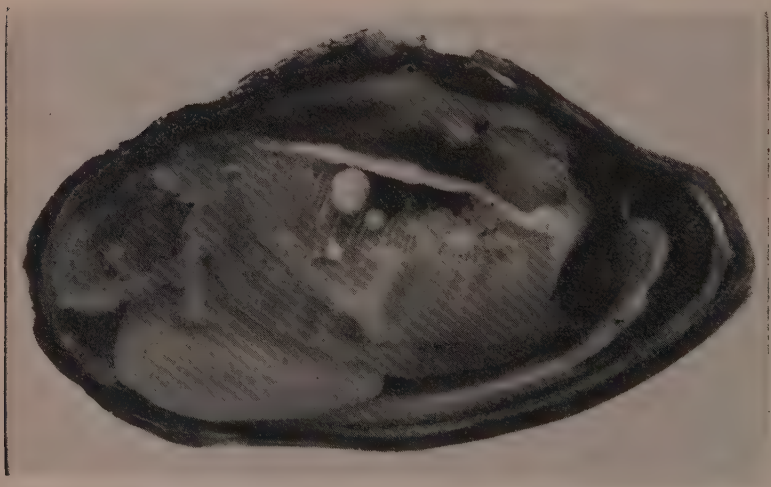

Fig. 4. *Anodonta cataracta* with left valve and mantle removed and left outer suprabranchial chamber opened to show papillae, a male and a female *N. ingens,* and several small, dark egg masses. (xl.5)

Summary

Najadicola ingens is reported from 43 localities in Massachusetts, Rhode Island, Vermont, New Hampshire, Maine, Quebec, and New Brunswick, after an examination of 3077 fresh-water clams from 74 localities in New England and adjacent areas of Canada. The mite parasitizes principally two host clams, *Anodonta cataracta* and *Elliptio complanatus,* and occasionally *Lampsilis radiata.*

The smaller and presumably younger *A. cataracta* and *E. complanatus* are parasitized more often than larger individuals. In *A. cataracta* the mites occur mostly in the outer suprabranchial chambers, but in *E. complanatus* in the inner suprabranchial chambers. The walls of the suprabranchial chambers containing mites almost invariably bear numerous papillae. The presence of mites in gravid gills apparently interferes with the normal use of the gill as a marsupium.

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NOTES ON THE HABITS AND HABITAT OF *GEOTRUPES CHALYBAEUS* LECONTE IN FLORIDA[1]

By Frank N. Young

Geotrupes chalybaeus described by LeConte[2] from fragments found at Tampa, Florida has long been a rarity in collections. This rarity seems to be due to the restricted habitat of the species and to its occurrence in the winter and early spring months. In many areas of "Scrub" vegetation on St. Lucie and other deep sands it is relatively common, and can be trapped in numbers by burying pint jars up to the neck in the ground and placing an inch or so of molasses and water, honey and water, or decaying mushrooms in the bottom.[3] Careful examination of other unusual habitats and use of different methods of collecting will probably reveal that many "rarities" are really quite common when their exact habitat is known.

In February, 1949, I stumbled upon a "colony" of *Geotrupes chalybaeus* in a small area of scrub in Putnam County south of Interlachen, Florida. The abundance of this supposedly rare beetle in this situation aroused my interest and subsequent collecting and observation indicated that the species extends over most of the dry sand areas of northern peninsular Florida. Its burrowing habits seem to restrict it to deep sands, and it can probably be expected wherever such occur within its range—possibly as far north as Maryland. There is some indication that local populations differ, but further study will be necessary to determine the significance of this variation.

The area in which the beetles were first observed south of Interlachen is largely covered by a stand of mature sand pines (*Pinus clausa*)[4] on St. Lucie sand on top of an elevation completely surrounded by the ground-water podzols of the Leon-St. Johns series

[1]Contribution No. 431 from the Department of Zoology, Indiana University and from the Department of Biology, University of Florida.

[2]Coleoptera of Florida, *Proc. Amer. Philos. Soc.*, 17, 1878: 402.

[3]See also Hubbell, T. H. A monographic revision of the genus *Ceuthophilus, Univ. of Fla. Publ., Biol. Sci. Ser.*, 2(1), 1936, for further notes on methods of using "molasses traps."

[4]Plant names are after Davis, J. H. Natural features of southern Florida, *Fla. Geol. Surv., Bull.* 25, 1943.

of "Flatwoods" soils. The area actually represents an island, probably developed as an offshore bar in the Pamlico or earlier sea, of the late Pleistocene epoch. It appears as an isolated, low hill about a mile in diameter (Putnam County, T-11-S, R-25-E, Sec. 17) on the topographic map of Florida (Contour Topographic Map, scale 1:500,000) prepared by the U. S. Engineer Department. The high central part of the "island" is almost pure sand pine scrub surrounded by a zone of *Quercus laevis-Pinus palustris* associes which grades through an ecotonal belt of *Quercus cinerea-Pinus palustris/ Pinus elliotti* into the *Pinus palustris-Aristida* associes on Leon sand —in local terms "Scrub" surrounded by "High Pine-Turkey Oak" grading through "High Pine-Blue Jack Oak" into "Long Leaf Pine Flatwoods".

Large specimens of the sand pine (*Pinus clausa*) cover the central portion of the "island" so closely that there is almost no ground vegetation except for a few small and scattered scrub oaks (*Quercus chapmani, Q. myrtifolia,* and *Q. virginiana geminata*), straggling patches of sedges and wire grass, and a few stunted *Xolisma, Garberia,* and other shrubs. A very few specimens of *Ceratiola ericoides,* the Scrub Rosemary, were found after some searching. The surface of the sand beneath the trees is covered with a thin mat of pine needles which together with an occasional fallen pine trunk, scattered plants of reindeer moss (*Cladonia* spp.), and occasional polypore and other mushrooms give the surface a characteristic aspect. The porous nature of the soil makes this a very dry situation. It was noticed on several occasions that the surface sand would be quite dry a short time after a heavy rain.

In late February, I found yellowish mounds of sand scattered over the pine needle mat in every direction. It was soon discovered that these mounds marked the burrows of *Geotrupes chalybaeus* since an occasional specimen could be dug out of the burrow beneath a mound by quickly thrusting a trowel or shovel into the ground so as to intercept the burrow. In a relatively small area, about 50 by 100 feet, along the western edge of the pines almost a thousand mounds were counted. This was the maximum density encountered, although some were found almost everywhere the sand pines occurred. Not all were fresh, many showing the slumping effect produced by rains, and some were so old that only the difference in color indicated their former position.

A series of "molasses traps" was extended from the edge of the

scrub area across the thickest concentration of the mounds and about 150 feet farther into the pines. About 50 jars and cans were used placed about 5 to 10 feet apart. Several days later, as many as 15 *G. chalybaeus* were found in a single jar, the number generally being highest near the greatest concentration of mounds. No specimens were taken in the five traps which extended outside the sand pine area, probably because of the density of the wiregrass which interfered with the movements of the beetles.

Burrowing Habits

Geotrupes chalybaeus is a remarkable burrower. The burrows beneath the mounds or "throwups" descend practically straight down, and apparently offer no particular difficulties to excavation, but the loose sand falls into burrows so readily it is very difficult to reach the bottom. In early March, several burrows were excavated to a depth below 60″ below which they were lost or the sand caved in upon them. One burrow was excavated to a depth of 61″ at which point it turned abruptly at right angle and ran 3″ more before coming to an end at which a small female beetle was found among some pine needles and male pine cones. None of the burrows excavated gave any clue as to the possible larval or adult food. Old burrows which might have contained larval chambers could not be traced because they had filled with sand to within a short distance of the surface.

The mounds or "throwups" are quite characteristic and easily identified once they have been seen. Groups of typical mounds found in many places seldom failed to produce at least a token specimen or be associated with fragments caught in spider webs beneath logs or rocks. In size the *G. chalybaeus* "throwup" is intermediate between that of smaller *Geotrupes, Bolboceras,* etc. and the smallest pocket gopher mounds. A typical "throwup" is about 6″ long by 5″ wide by 1½ to 2″ high. The burrow (about ⅞″ in diameter) opens under one end of this small mound and is usually loosely closed with a plug of damp sand. In the fresh burrows a small clump of roundish roll of damp sand broken into small segments indicates the end of the mound at which the burrows opens. Occasionally this roll of damp sand was seen being pushed out of the burrow, and once a beetle was taken by thrusting a trowel into the soil beneath the end of the roll. It seems very probable that the beetle excavates its burrow by bringing up small pellets of damp sand from the bot-

tom and pressing them against the bottom of a plug which is gradually forced out upon the surface. Such a method would allow the burrow to be closed most of the time, which might be of value in preventing excess evaporation in so xeric an environment. Burrows in which the mouth was open were in many cases filled with sand a little ways beneath the surface. This sand seemed to have been washed in rather than being a plug formed by the beetles.

Aboveground Activities

Night observations revealed a few males and females on the surface among the mounds. No feeding, mating, or other activities were observed, however, since all specimens found were lying on the pine needle mat and did not move while under observation which in some cases lasted as long as half an hour. The smaller size of the females in relation to the males and the grouping together of the mounds suggests that some sub-social activity might be expected. Presence of light in the area and other activity may have disturbed the beetles because the trapping results indicated that there was considerable wandering about at night.

Food

The only information on food is indirect. Adult beetles were attracted to molasses and water, honey and water, decaying mushrooms, and molasses-honey-mushrooms and water. Some specimens were trapped in empty jars or jars containing only water. Jars containing cow manure, horse dung, or human excreta seemed to repel the beetles since none were taken in such traps although others in the same area fell into empty jars. Molasses and honey caught more beetles than decaying mushrooms, but the latter did not trap the beetles as did the sticky solutions so that many more may have visited the mushrooms and then left. The amount of possible food in such a situation as the "Scrub" is rather limited, but mushrooms and various lichens are frequently very abundant.

Distribution In Florida

"Throwups" accompanied by fragments or specimens of *G. chalybaeus* were found in a number of places in northern peninsular Florida. All were located in areas of St. Lucie, Lakeland, Chiefland, or Orlando sands. None were found in St. Lucie or Dade sands in

southern Florida during June, 1949, but search in the period from January to May might reveal them. The largest "colony" found beside the one near Interlachen was near Belleview in Marion County. Several hundred "throwups" were found there in deep Lakeland sand supporting the *Quercus laevis-Pinus palustris* associes. Typical "throwups" were also found in the "Big Scrub" south of the Oklawaha River, but no beetles were taken.

Florida counties from which records were established are: Gilchrist (2 localities), Levy (2 localities), Alachua (2 localities, also records by T. H. Hubbell), Putnam [3 localities, also Welaka (A. F. Van Pelt and J. C. Moore), and north of Palatka (H. K. Wallace)], Volusia (1 locality), Marion (2 localities), and Hernando (1 locality.) All of these localities were in areas of *Pinus clausa-Ceratiola ericoides* associes or *Quercus laevis-Pinus palustris* associes. In nearly all cases they were associated with mounds of pocket gophers (*Geomys* spp.) and the gopher tortoise (*Gopherus polyphemus*).

All specimens are in the collection of the University of Michigan Museum of Zoology, Ann Arbor, Michigan.

Chalepus bicolor Oliv. (Coleoptera).—This species has not been listed north of Connecticut but I took one here on June 19, 1942, by sweeping. About a dozen were taken here on August 2 and 10, 1947, on *Panicum scribnerianum* Nash. The determination of this grass was obtained through the kindness of Dr. I. M. Johnston of the Arnold Arboretum. Another specimen of the beetle was obtained by sweeping in the Quabbin Reservation in Ware, Mass., June 26, 1947. My other specimens are from South Carolina, Indiana, Florida and Connecticut.—C. A. Frost, Framingham, Mass.

POLYHOMOA AZUMA, A SYNONYM OF *KYIDRIS* BROWN (HYMENOPTERA: FORMICIDAE)

By William S. Creighton

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During April of 1950 the writer received from Professor Masao Azuma of Nishinomiya, Hyogo Prefecture, Japan, a short paper dealing with Japanese ants. The paper is a separate from Volume 1, No. 4 of a publication entitled *Hyogo Biology*. Its pages are numbered 34-37 and it bears the date 30 Aug. 1949. As I shall subsequently show, this date is the acceptance date of the article, not its date of publication.

As the paper is almost entirely in Japanese I could make little of it other than to note that it carries the original description of a new genus *Polyhomoa*. Some weeks later Dr. Wm. Brown, who had meanwhile had the paper translated into English, informed me that *Polyhomoa* is the same as his *Kyidris* and that, if the date on the reprint represents its time of publication, Azuma's name would take precedence. The original description of *Kyidris* Brown was published in the Japanese journal *Mushi* in the issue which appeared on September 20, 1949 (Vol. 20, pars 1, p. 3.) Dr. Brown made various efforts to learn the significance of the date on Azuma's article. The only positive response came from Dr. Yasumatsu, to whom Dr. Brown had applied for information. According to Dr. Yasumatsu the date of publication of *Hyogo Biology*, Volume 1, No. 4 was January 10, 1950. This strongly suggested that the date carried on Azuma's article was an acceptance date. The verification of this surmise required access to the entire number of *Hyogo Biology* containing Azuma's article. With the distribution of the journal restricted to Japan, this possibility seemed remote. However Miss Hazel Gay, the Librarian of the American Museum of Natural History became interested in the problem and was able to secure a full file of *Hyogo Biology* (Volume 1, Nos. 1-4) for the Museum library. As nearly as can be ascertained, this is the only set of this journal in the United States and Miss Gay is to be congratulated on the success of her efforts.

The articles which compose the Number 4 issue of *Hyogo Biology* are separately dated during the year 1949. The dates run from

March to September, at which time the number was apparently closed and sent to the printer. The printing of the issue consumed three months. In consequence, the cover bears the date of publication, January 10, 1950.

This being the case, the genus *Kyidris* Brown takes precedence over the synonymic genus *Polyhomoa* Azuma. As to whether Azuma's species *itoi* is a synonym of Brown's *mutica* is not certain but it seems probable that this is the case.

Massachusetts Records of *Cyphoderus assimilis* Borner (Collembola).—During the last three years, specimens of this species have been recovered in the field from ant nests in four localities in Massachusetts. The species has been taken from Annisquam in May, June, and July, from Boston in September, from Swampscott in September, and from Cambridge in October. In the New World this species is ordinarily found in tropical and subtropical areas, and when taken in more northerly regions it is usually in such artificially sheltered areas as greenhouses. Its occurrence in Massachusetts may be only a local invasion, but that this has been successful to some extent is shown by the recovery of specimens in one area (Annisquam) in three successive years. Although the species has not been found outside of ant nests, it shows little selectivity as to the ant, having been found in nests of *Aphaenogaster, Acanthomyops, Chthonolasius, Lasius,* and *Tetramorium.*—K. A. Christiansen, Biological Laboratories, Harvard University.

SOME NEW NEARCTIC COLLEMBOLA

By D. L. Wray
Raleigh, N. C.

The insect order Collembola seems to have as extensive geographical distribution as any other animal group. Many species are very widely distributed geographically, but some are limited to particular ecological situations. A few years ago I described *Tetracanthella ethelae* taken here at Raleigh, N. C., at an altitude of only 325 feet. The habitat of this genus was the Arctic regions of North America and the higher mountainous regions of Europe and Asia. This past year *T. ethelae* was taken near the top of Mt. Mitchell, at an altitude of about 6500 feet and up on the side of Grandfather Mt. at an altitude of about 5000 feet. Hence here is a species with a wide range as to both altitude and geographical distribution. Recently in some material sent to me for study by Dr. G. F. Knowlton from Utah I found a *Tullbergia* having three anal horns, a form very close to the European *T. affinis* Börner. Bonet (1944) has described a form (*Mesaphorura incisa*) with three anal horns from Mexico. Of particular interest is the occurrence of another European form (*Xenyllodes armatus* Axels.) in North America fauna. A note on this species is given below.

The forms described in this paper are *Tullbergia knowltoni* (*Onychiurinae*), *Onychiurus wilchi* (*Onychiurinae*), and *Folsomia highlandia* (*Isotominae*).

Family Entomobryidae.

Genus *Folsomia* Willem.

Folsomia highlandia, n. sp.

(Figs. 10-17)

Length up to 1.8 mm. Dirty gray in color, speckled with purplish-black pigment over head and body segments dorsally and ventrally. The pigment is noticeably heavy on the frontal area of the head (Fig. 16). The pigment on the body segments is heavier on the

median portion, each margin lightly pigmented, or with it entirely lacking, giving the body a banded appearance. Antennae slightly pigmented basally, lighter distally. Basal segments of legs pigmented, lighter distally. Manubrium lightly pigmented basally.

Eyes (Fig. 13) 4 on each side of head, equal, three anterior ones close together on a dark eye patch, the posterior one is situated back of others about 4 eye-diameters on a dark eye-patch. Postantennal organ (Fig. 13) unusually elongate, bent, and 6 or 7 times as long as the diameter of adjacent eye, notched in middle. Antennae as long as head on well developed antennal base. Antennal segments as: 7:15: 10:30. Sense organ of third antennal segment (Fig. 11) consisting of two small, slightly bent sense rods. Fourth antennal segment with several olfactory setae. Last three abdominal segments ankylosed, sometimes with a trace of a suture showing between fourth and fifth segments.

Unguis (Fig. 10) curved, unarmed. Unguiculus (Fig. 10) unarmed, broadly lanceolate, and extended setaceously; about two-thirds the length of unguis. Tenent hairs absent. Furcula reaching to the middle of the second abdominal segment. Manubrium (Fig. 12) with several fine, short setae dorsally and with many short, stout setae ventrally. Manubrium to dens to mucro as: 25:35:5. Dentes (Fig. 15) with a long basal seta and at least 3 shorter, curving setae dorsally; with many short, rather stout setae ventrally; dorsally crenulate, the crenulations ending about two mucro-lengths from mucro. Mucro (Fig. 15) large, bidentate, the apical tooth much smaller than ante-apical. Rami of tenaculum quadridentate, with one stout, curving seta on corpus (Fig. 14).

Clothing at posterior end of abdomen composed of very many long setae intermingled with shorter, curving ones. Clothing on body segments (Fig. 17), from a lateral view, generally consists of two long, curved setae, and numerous shorter, reclinate ones. Body in general unusually heavily clothed with setae.

This species is very close to an eight-eyed species (*Folsomia octoculata* Handschin) described from Java and the South-west provinces of India, as to number and arrangement of eyes, but differs in other body structures.

Highlands, N. C., September 22, 1949, D. L. Wray. Eighteen specimens were taken from leaf mould from a mixed pine, hemlock, and hardwood forest at about 4000 feet altitude. This region stays

rather moist due to the very heavy yearly rainfall making it ideal for collembolan fauna. Cotypes in author's collection.

Family Poduridae.

Genus *Tullbergia* Lubbock.

Tullbergia (Mesaphorura) knowltoni, n. sp.

(Figs. 1-9)

Length up to 0.7 mm. White. Slender (Fig. 1), body five times as long as broad. Antennae short, two-thirds as long as head, the third and fourth segments not distinctly separated. Relative lengths of antennal segments as: 3:4:6:5. Antennal base well developed. Fourth antennal segment with a terminal sense knob and with 6 to 8 large, curving olfactory setae (Fig. 4). Organ of third antennal segment (Fig. 5) with three guard setae, two large sub-reniform sense clubs, curving toward each other, and two large papillae shielding the sense clubs; ventro-laterally to these is an auxilliary sense club. Postantennal organ in an elongated groove, with about 24-28 irregular tubercles (Fig. 3), somewhat shaped like the *Onychiurus fimetarius* group postantennal organ. Pseudocelli, rosette-like, situated on each side as follows: 1 between postantennal organ and base of antenna, 1 on posterior part of head, 1 on mesothorax and metathorax, and with 1 on abdominal segments I-V, wanting on abdominal segment VI.

Unguis (Fig. 8) unarmed. Unguiculus absent. Anal horns (Fig. 7) 3; two long, strongly curved ones about twice the length of the hind unguis are situated on the postero-dorsal end of body on large nearly contiguous papillae; the third horn is short, bluntly rounded at apex, in length about half the unguis, and is situated mid-ventral to the pair above.

Body with short backward curving setae in three rows on mesothorax to abdominal segment V. Longer setae intermingled in one row on each segment and are more abundant on head and 5th and 6th abdominal segments. The 6th abdominal segment with two rows of long curving setae. Integument granulate, becoming coarser dorsally on the posterior margin of thorax II to abdominal segment V.

Logan, Utah, October 31, 1949, G. F. Knowlton and S. C. Ma. Taken in honeysuckle leaves by means of a modified Berlese funnel. Cotypes at present in author's collection.

This species is very close to *Tullbergia affinis* Börner in the arrangement and size of the 3 anal horns, but differs in that pseudocelli were not observed on thorax I, the unguiculus was not distinguished, the size is smaller, and there seems to be differences in the organ of the 3rd antennal segment and postantennal organ.

Genus *Onychiurus* Gervais.

Onychiurus wilchi, n. sp.

(Figs. 18-25)

Length up to 1.5 mm. White. Postantennal organ (Fig. 20) of the *fimetarius* type, each with 18-20 branched tubercles placed at right angles to the long axis. Antennae shorter than the head, with the antennal segments in the following proportions: 7:13:15:17. Organ of the third antennal segment (Fig. 19) with 5 papillae, 5 guard setae, 2 sense rods, and 2 sense clubs. Fourth antennal segment with 10-12 curving olfactory hairs. Pseudocelli (Fig. 18) on each side as follows: 2 on inner side of antennal base and one between antennal base and postantennal organ; 2 obliquely situated on back of head; meso- and meta-thorax 2; 2nd and 3rd abdominal 2; 4th and 5th abdominal 3. One pseudocellus on each precoxal.

Unguis (Fig. 21) stout, curving, unarmed. Unguiculus unarmed, slender, gradually tapering to apex which is extended in the form of a fine filament to length of unguis. Anal spines 2 (Fig. 23), stout, and almost straight, bases widely separated; two-thirds as long as hind unguis. Long curving setae at posterior end of abdomen. Clothing of scattered long straight setae, sparse short setae, and a few minute strongly curved setae (Fig. 24). Cuticular tubercles (Fig. 23) coarse.

Highland, Illinois June 7, 1946, B. T. Wilch. This species is named for Mr. B. T. Wilch who collected fifteen specimens from garden soil, and which were transmitted to me for study by Dr. H. H. Ross, of the Illinois Natural History Survey, with whom most of the cotypes will be deposited.

Genus *Xenyllodes* Axelson, 1903.

Eyes 5 on each side of head. Postantennal organ consisting of a single, trilobed tubercle. Antennae with broad basal segments,

almost touching, distally segments become conical. Mouthparts reduced. Unguis unarmed. Unguiculus present. Furcula shorter than antennae; manubrium slightly longer than dens, which is slightly longer than mucro. Anal horns 2. Integument finely granulated. Body short, thick, length up to 1 mm.

Xenyllodes armatus Axelson 1903.

(Figs. 26-30)

This form from Raleigh, N. C., collected from leaf mould has been referred to this species as it agrees very well in most essential characters with the description given by Axelson (1912), and also with that by Dr. Jan Stach (1949). However, it does vary in some characters, such as the length of the anal horns, postantennal organ, and furcula measurements, from the illustrations given by Axelson. This is probably the first time this genus has been recorded as occurring in North America. The form from here has been examined by Dr. H. B. Mills, Illinois Natural History Survey, and credit is given him as first recognizing this form as occurring in North America as he states that he found it in Montana, previously to the ones I sent from this locality. As far as we are aware this genus has not been in North American literature as yet. Dr. Jan Stach (1949) states that till now this species is only known from Europe. Thus, this is an interesting extension of the range of this genus and as with other genera, when more intensive collecting is done, one may expect or not be surprised to find an ever widening geographical distribution.

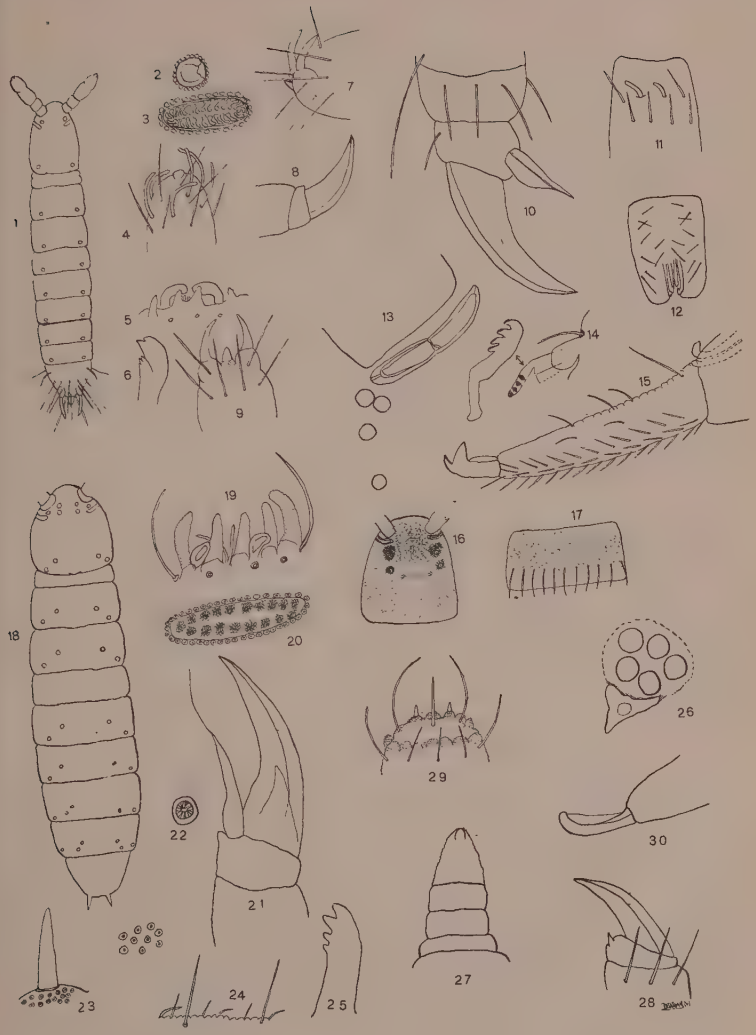
Description of North Carolina form. Eyes 5 (Fig. 26) on each side of head, equal in size on a dark eyepatch. Postantennal organ consisting of a single, trilobed tubercle with a round "central organ"; situated in a depression close to front of the eye complex (Fig. 26). Antennae with broad basal segments, almost touching, distally segments become conical (Fig. 27); shorter than head, relative lengths of segments as: 3:5:5:8. Fourth antennal segment with a rounded lobe at tip, and with 5 or 6 olfactory hairs. Mouthparts reduced. Unguis (Fig. 28) unarmed. Unguiculus present but weakly developed, small, spinnate. Furcula well developed, shorter than antennae; manubrium slightly longer than dens, which is slightly longer than mucro (Fig. 30). Anal horns 2, very small but well developed (Fig. 29). Integument finely granulate. Clothing of

short, curving setae; posterior end of abdomen with longer curving setae (Fig. 29). Length 0.4 mm. White with bluish tinge mainly on head.

I wish to express my many thanks and appreciation to Dr. G. F. Knowlton and Mr. S. C. Ma for material from Utah, to Dr. H. B. Mills for his notes on *Xenyllodes,* to Dr. H. H. Ross for material from Illinois, and to Dr. Hermann Gisin, Genève, Switzerland, for making available specimens of *Tullbergia affinis* Börner from Europe.

Explanation of Plate 5

Tullbergia knowltoni, n. sp. (Figs. 1-9) 1. Dorsal view of the whole animal. 2. Ocellus. 3. Postantennal organ. 4. Tip of fourth antennal segment. 5. Organ of third antennal segment. 6. Mandible. 7. Posterior end of abdomen showing anal horns. 8. Unguis. 9. Ventral view of posterior end of abdomen. *Folsomia highlandia,* n. sp. (Figs. 10-17) 10. Hind foot. 11. Organ of third antennal segment. 12. Dorsal surface of manubrium. 13. Eyes and postantennal organ. 14. Tenaculum. 15. Dens-mucro 15. Dorsal surface of head. 17. Pigmentation of body segment, dorsal surface scheme. *Onychiurus wilchi,* n. sp. (Figs. 18-25) 18. Dorsal view of whole animal. 19. Organ of third antennal segment. 20. Postantennal organ. 21. Hind foot. 22. Ocellus. 23. Anal horn. 24. Clothing arrangement of setae. 25. Mandible. *Xenyllodes armatus* Axelson. (Figs. 26-30) 26. Eyes and postantennal organ. 27. Antenna showing round knob at tip. 28. Hind foot. 29. Posterior end of body, dorsal view, showing anal horns. 30. Dens-mucro.



WRAY—COLLEMBOLA

ANT LARVAE OF THE SUBFAMILY CERAPACHYINAE

By George C. Wheeler

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The Cerapachyinae are a neglected group of ants even among myrmecologists. This may be attributed to a combination of factors; the subfamily is a small one, about one hundred species; all species are rare and sporadic; their colonies are small; nearly all are tropical; they have no spectacular habits or bizarre structures; they are of no economic importance.

Nevertheless, they are a very interesting group phylogenetically, since they show both doryline and ponerine affinities. In fact, they have been included in both subfamilies. Forel in 1893 first recognized the group of genera as a tribe and placed it in the Ponerinae. In 1895 Emery transferred it to the Dorylinae. After protests from Forel and Wheeler he returned it in 1913 to the Ponerinae as the Section Prodorylinae. Wheeler considered the group to be intermediate between the Dorylinae and the Ponerinae and in 1920 elevated it to the rank of subfamily. It is especially significant here that he used larval as well as adult characters to justify this change.

In view of the neglect just mentioned, it is surprising that so many cerapachyine larvae are known: six species representing four of the eight genera.

Subfamily Cerapachyinae Forel

Elongate and very slender; subcylindrical; arcuate, i.e., the whole body rather evenly curved ventrally. Segmentation distinct. Spiracles small. Vestigial legs present or absent. Head small; at the anterior end. Mouth parts large and prominent. Head hairs few, short and nearly always simple. Antennae moderately large, with two or three sensilla. Labrum a thick flap, usually small. Mandibles rather feebly sclerotized; typically long and slender; base moderately stout; distal two-thirds narrow and thin; tapering to an apex which is slightly curved backward and medially; medial border serrate. Maxillae lobose; mostly rather long and round-pointed; palp small, a cluster of three to six sensilla or a low elevation bear-

ing sensilla or a short obtuse projection bearing sensilla; galea a slender conical projection bearing a single apical sensillum. Labium large and prominent; palp a cluster of three to five sensilla, sometimes slightly elevated. Opening of sericteries mostly well developed. Trophorhinium poorly developed or absent.

Emery (1911) describes the larvae (under Section Prodorylinae of the Subfamily Ponerinae) as "uniformément poilues, sans tubercules piligères" (p. 4) and "à peu près cylindrique (comme la larve d'*Eciton*) revêtue de poils courts et san tubercules piligères" (p. 5).

Wheeler, 1903, pp. 208-209: "What light do these few observations, together with those recorded in my previous paper, shed on the affinities of the Cerapachyi to the Ponerinae on the one hand and the Dorylinae on the other? . . . The following characters [of *Cerapachys augustae*] are common to both Dorylinae and Ponerinae:— 1. The method of carrying the larvae is common to forms like Eciton and Leptogenys. 2. The larva is intermediate between that of Eciton and Stigmatomma. It is covered with shorter, less flexuous, and less abundant hairs than the latter and in these particulars resembles the larvae of Eciton."

Wheeler, 1920: "During the past year a study of ant-larvae, representing more than a hundred genera and many subgenera of all five subfamilies, has convinced me that Emery was right in 1899, when he regarded the Pseudomyrminae as constituting an independent subfamily. I am also of the opinion that the Cerapachyini should be removed from the Ponerinae and raised to the rank of an independent subfamily, between the Dorylinae and the Ponerinae" (p. 46). "A study of the larvae of the Cerapachyini shows that they are extremely like the larvae of the Dorylinae. This was noticed by Emery in his observations on the larva of *Acanthostichus serratulus* (1899). The mandibles are small, narrow, pointed and rather feebly chitinized, and I have failed to find a trophorhinium in either group. Apparently the young are fed only on soft food" (p. 50). On page 48 he states that the larvae of the Cerapachyinae are exceptional in not having a beautifully developed trophorhinium.

Wheeler, 1922, p. 52: "The larvae are extremely like those of the Dorylinae; they are elongate and almost cylindrical, uniformly covered with short hairs, and without piliferous tubercles. The mandibles are small, narrow, pointed, and rather feebly chitinized, and I have failed to find a trophorhinium, or triturating organ in the mouth. Apparently the young are fed only on soft food."

Tribe Cerapachyini Forel

Genus *Eusphinctus* Emery

Diameter greatest at the sixth abdominal somite decreasing gradually toward the anterior end (except for a slight enlargement of meso- and metathorax in mature larvae) and more abruptly toward the posterior end. No leg vestiges. Hairs rather numerous, uniformly distributed, short and bifid. Cranium about as long as its greatest breadth; broad above, narrowed below. Head hairs simple (except one or two pairs which are bifid) and minute. Labrum small, not covering the bases and tips of mandibles; about twice as broad as long; slightly narrowed distally; a few sensilla on the anterior surface near the distal border; central cluster of sensilla on the posterior surface. Maxillary palp a short stout peg. Labium with a few spinules.

Eusphinctus steinheili Forel.—Figure 1. Elongate, slender, subcylindrical, arcuate (i.e., rather evenly curved ventrally). Diameter greatest at the sixth abdominal somite; decreasing gradually toward the anterior end (except in mature specimens in which there is a slight enlargement of the meso- and metathorax) and more abruptly toward the posterior end which is round-pointed. Anus ventral. Anterior portion of prothorax constricted rather abruptly to form a sort of wedge-shaped neck, which is naked except for a few ventral hairs. Ten differentiated somites. No leg vestiges. Spiracles small. Body uniformly and rather densely covered with short bifid hairs about 0.04 mm. long. Intersomitic membranes and anterodorsal surface of prothorax naked. Head small. Cranium about as long as its greatest breadth; broad above, narrowed below; occipital border slightly curved. Mouth parts large and prominent. Head hairs few and scattered; one or two pairs bifid, the rest simple; minute (length 0.018 - 0.028mm.). Antennae of moderate size; with two or three sensilla. Labrum a small thick flap, about twice as broad as long, slightly narrowed distally; a few sensilla on the anterior surface near the distal border; a central cluster of six sensilla on the posterior surface. Mandibles rather feebly sclerotized; long and slender; base moderately stout; distal two-thirds narrow and thin, tapering to an acute apex which is slightly curved backward and medially; distal half of medial border serrate with five or six denticles. Maxillae lobose, round-pointed, rather long; palp a short stout projection bearing five or six sensilla; galea a slender truncate cone bearing a sensillum on the apex. Labium subhemispherical;

capping the ventral end of the gula; anterior surface with a few minute spinules in regular transverse rows (concealed behind labrum); palp a cluster of three sensilla. Opening of sericteries a long transverse slit. (Material studied: several larvae from New South Wales.)

Wheeler, 1918: "Long and slender, cylindrical and not enlarged at the posterior end, with eleven distinct postcephalic segments, all uniformly clothed with short, erect, two-branched hairs. Head small, as broad as long, with vestigial antennae and long falcate mandibles, which have finely serrate internal borders. There are few hairs on the head and these are simple, with the exception of a pair near the occipital border, which are two-branched like those on the body. The color of the larva is dull white" (p. 228). Fig. 2 shows a larva in side view, a head hair, the head in anterior view and a mandible (p. 227).

Wheeler, G. C., 1938; no leg vestiges (p. 140); no vestigial gonopods (p. 142).

Genus *Cerapachys* F. Smith

Leg vestiges small paraboloidal papillae. Body hairs simple. Head (including mouth parts) subpyriform in anterior view; cranium transversely subelliptical; occipital border slightly curved. Head hairs short. Labrum small, not covering the bases and tips of the mandibles; breadth one and one-half times the length; constricted near the base; free border strongly curved; numerous sensilla on the free border and posterior surface; posterior surface spinulose near periphery. Maxillae with the apical half spinulose; palp a low elevation together with a contiguous papilla. Labium with spinules on the middle of the anterior surface.

Cerapachys (*Syscia*) *cryta* Mann.—Fig. 2 a-d. Anterior portion of prothorax constricted abruptly to form a short wedge-shaped neck. Vestigial legs a pair of small paraboloidal papillae on the ventral surface near the middle of the posterior border of each thoracic somite. Spiracles small. Body hairs few, very long (0.4-0.6 mm.), simple, flexuous and extremely slender; longest and most abundant near posterior end; also a very few minute (0.013 mm.) stiff hairs. Head (with mouth parts) subpyriform in anterior view; small; mouth parts large and prominent; cranium transversely subelliptical. Head hairs few and scattered; simple, slightly curved, short (0.036 mm.). Antennae moderately large; each with three

sensilla. Clypeus distinct; a thick flap. Labrum a thick flap; small; broader than long; constricted near base; free border strongly curved and bearing several conspicous sensilla; posterior surface with numerous sensilla near the middle and with spinules arranged in short arcuate rows near the periphery. Mandibles rather feebly sclerotized; long and slender; base moderately stout; apical two-thirds narrow, thin, curved backward and medially, and tapering to a rounded point; apical half of medial border serrate wih five or six denticles. Maxillae lobose, round-pointed, rather long; apical half spinulose, the spinules grouped in short rows; palp a low elliptical elevation (bearing two sensilla) together with a contiguous papilla (which bears an apical sensillum); galea a long slender finger-like projection bearing an apical sensillum. Labium prominent, constricted at the base; free end broadly rounded; middle of anterior surface spinulose, with the spinules arranged in short transverse rows; palp a low rounded elevation (bearing three sensilla) together with a contiguous paxilla (bearing a single apical sensillum). Opening of sericteries distinct. (Material studied: three semipupae from Fiji collected by Dr. W. M. Mann.)

Cerapachys (*Cerapachys*) sp.—Fig. 2e. Similar to *crypta* but differing in a few details. The body hairs are shorter (0.2 - 0.3 mm. long) but more abundant. The head hairs are longer (0.054 mm. long). The mandibles have more denticles (about a dozen on each). The maxillary palp is a low elevation bearing four sensilla. The labial palp is a low elevation bearing five sensilla. (Material studied: 10 semipupae from Borneo.)

Wheeler, G. C. 1938, p. 141: no evidence of wing rudiments.

Cerapachys (*Parasyscia*) *augustae* Wheeler.—Text fig. 1. "The larvae were extremely slender, not twice as broad behind as at the anterior end, with well-marked segmental constrictions. The head is proportionately large, with strong, acute mandibles projecting beyond the clypeal and labial regions. The maxillae are furnished with a pair of prominent sensory papillae and the labium with a well-developed duct to the spinning glands. The dorsal surface of the head as well as the whole surface of the body is covered uniformly with short, slightly curved hairs. There are no traces of tubercles of any description. Attempts to observe the method employed by the ants in feeding their larvae were unsuccessful. Once, on placing a number of eggs and young larvae of *Camponotus festinatus* in the nest I saw the young Cerapachys larvae feeding

Text-figure 1.—*Camponotus pennsylvanicus* worker and 9, young larva in lateral view. After Wheeler, 1908 and 1911, by permission of Columbia University Press.)

...m the former after they had been carried under the skin by the workers. It was apparent also that the ants and their older larvae were vegan to feed on the unhatched eggs and younger larvae of the same species, for the number of progeny decreased rapidly from day to day . . . These larvae were carried by the ants after the manner of Eciton and Leptogenys, i.e., by the neck, with the long slender body extending back between the legs of the worker. The ants were quite as careful of their larvae as of their eggs." (Wheeler, 1911, p. 247.) The figure of the young larva on page 248 is reproduced by Wheeler (1910, Fig. 27 on p. 71) and is reproduced here (Text-fig. 1) through the courtesy of Columbia University Press.

Wheeler (1911, p. 248) "The larva probably plays a curious . . . The larva is intermediate between that of Eciton and Stegomyrmex. It is covered with shorter hair because, and has abundant hairs like the latter and in these particulars resembles the larvae of Ponera."

Wheeler (1911) describes the larva of *Paraponera* as "more spiniform" than typical ant larvae (p. 72), and as "smooth, slender . . . with a rather dense covering of hairs" (p. 253).

Genus *Leoponera* Mayr

Diameter least at the first abdominal somite, increasing toward either end. No leg vestiges. Body hairs of three types: (1) long and flexuous with the tip hooked; (2) short and simple; (3) minute and simple. Cranium subhexagonal in anterior view; occipital border broadly angulate. Head hairs minute or short. Labrum large, covering most of the mandibles; width about three times the length; free border strongly curved; numerous sensilla on posterior surface. Mandibles short and stout; very feebly sclerotized. Maxillae very large and inflated; palp represented by a cluster of sensilla. No spinules on the mouth parts.

Lioponera luzuriagae Wheeler & Chapman.—Fig. 3. Elongate, slender, subcylindrical, arcuate (i.e., rather evenly curved ventrally); diameter least at the first abdominal somite, increasing gradually toward the ends. Anus subterminal. Eleven differentiated somites. No leg vestiges. Spiracles small. Body hairs of three types: (1) long (0.1 - 0.2 mm.) and flexuous, with the tip hooked, arranged in rows, one row of 6-12 hairs around each somite near the middle; (2) short (0.05 - 0.1 mm.), simple, slightly curved, sparsely and irregularly distributed, except on the prothorax, where they produce a bristly aspect; (3) minute (0.013 - 0.026 mm. long), simple, moderately numerous and uniformly distributed. Head small. Cranium subhexagonal in anterior view; a little broader than long; occipital border obtusely angulate at the middle. Head hairs very few; simple; variable in length (0.013 - 0.027 mm.), number and location. Antennae moderately large, each with three sensilla. Labrum a large thick flap twice as broad as long and covering most of the mandibles; with its base constricted and its free border broadly rounded; numerous sensilla on posterior surface. Mandibles very feebly sclerotized; short and stout; with the basal two-thirds greatly inflated and subtriangular in anterior view; distal third very small and curved posteriorly, its apex curved medially and blunt-pointed; distal half of medial border furnished with five to nine sharp denticles of various sizes and irregularly arranged. Maxillae very large, inflated, lobose; palp represented by a cluster of five sensilla; galea a small finger-like projection bearing an apical sensillum. Labium large and prominent; palp a cluster of five sensilla. (Material studied: several larvae from the Philippine Islands, collected by Dr. J. W. Chapman.)

A few of the larvae in the vial have branched hairs, but they also

have a very wrinkled integument. This latter causes me to suspect that they have been dried out and later relaxed. At any rate, they do not differ otherwise from the larvae described above. Hence I conclude tentatively that the branching may be an artifact due to dessication. Dimorphic larvae are extremely rare among the Formicidae. Without better evidence I would not wish to consider the larva of this species dimorphic.

Whether dimorphic or not, *Lioponera* larvae are still the queerest of the cerapachyines. Their hooked hairs and their short broad mandibles make them decidely atypical.

The only reference to the larva of *Lioponera* in the literature refers to the absence of vestigial legs in *L. luzuriagae* (G. C. Wheeler, 1938, p. 140).

Text figure 2.—*Acanthostichus serratulus*. *a*, nearly mature larva; b, head enlarged, in profile; c, same in dorsal (*sic!*) view; d, mandible greatly enlarged, viewed obliquely from the side. (After Emery, 1899)

Tribe Acanthostichini Emery
Genus *Acanthostichus* Mayr

I have seen no larvae of this genus and hence must be content with Emery's description (1899, p. 4) and figures (Pl. 2, figs. 5

a - d) of *A. serratulus* (F. Smith). His description is quoted and translated below and his figures are copied as Text fig. 2.

"Sono . . . subcilindriche, coi segmenti tutti distinti: sono prive di tubercoli o altre appendici e fornite di peli numerosi, brevi e semplici; non esistono peli forcuti, ritorti o uncinati . . . Il capo, benchè più piccolo e meno convesso che nelle Ponerinae è ben staccato dal tronco, e le mandibole sono lunghe, strette, sporgenti in avanti, fuori del labbro superiore; il loro margine interno è dentellato e offre alla base una forte dilatazione. Nelle mascelle, il cono più vicino all'apice è semplice e allungato; al posto del l'altro cono, si trova una sporgenza ottusa, fornita di due piccoli tubercoli."
[Translation: Subcylindrical, with all segments distinct; no tubercles or other appendages; furnished with numerous short simple hairs; no forked, twisted or uncinate hairs. The head, although smaller and less convex than in the Ponerinae is quite distinct from the body and the mandibles are long and narrow and project forward beyond the labrum; their medial borders are denticulate and strongly dilated at the base. The subapical cone of the maxillae is simple and elongate; in place of the other cone there is an obtuse projection furnished with two small tubercles.]

Discussion

The ant larvae of the Subfamily Cerapachyinae constitute a well defined group which may be distinguished from the larvae of other subfamilies by the elongate, very slender, subcylindrical body which is rather strongly curved ventrally; by the large and prominent mouth parts; by the paucity and shortness of the head hairs; by the rather feebly sclerotized mandibles, which are typically elongate and slender and have the medial border denticulate in part; by the inconspicuousness of the labial and maxillary palps; and by the absence (or scant development) of a trophorhinium.

Explanation of Plate 6

Eusphinctus steinheili Forel, Fig. 1. - a, head in anterior view, x 97; b, left mandible in anterior view, x 150; c, left mandible in side view, x 150; d, body hair, x 167; e, larva in side view, x 27. *Cerapachys* (*Syscia*) *crypta Mann*, Fig. 2. - a, head in anterior view, x 74; b, head in side view, x 74; c, two body hairs, x 100; d, right mandible in anterior view, x 100. *Cerapachys* (*C.*) sp. Fig. 2e, ventral view of vestigial legs, x 22. *Lioponera luzuriagae* Wheeler and Chapman, Fig. 3, - a, head in anterior view, x 120; b, left mandible in anterior view, x 387; c, three body hairs, x 167; d, larva in side view, x 20.

WHEELER—ANT LARVAE

Cerapachyine larvae most nearly resemble the larvae of the Dorylinae. Both types have an elongate subcylindrical body with the head at the anterior end; rather feebly sclerotized mandibles, which are typically elongate and slender and have the medial border denticulate in part; inconspicuous maxillary palps; and the trophorhinium wanting or poorly developed. They differ in that doryline larvae are a little stouter and more nearly straight, have more hairs on the head and have smaller mouth parts.

Cerapachyine larvae also show a marked resemblance in body shape to the larvae of the ponerine genus *Myrmecia*. The larvae of this genus have the posterior half of the body noticeably stouter than in the Cerapachyinae, but there is a gradual attenuation from behind forward; hence there is no sharply defined "neck" which is characteristic of the higher Ponerinae. Wheeler considered the adults of *Myrmecia* to be eminently primitive and generalized and the larvae the most primitive of existing Formicidae.

It seems therefore that the following hypothesis might be justified. The larva of *Myrmecia* represents an ancestral formicid type. From this type, by differentiation into a large "body" and a slender curved "neck", the higher Ponerinae evolved. But before this differentiation occurred, a side branch was formed, the larvae of which became more attenuated posteriorly. This line led to the Cerapachyinae. A secondary offshoot from it gave rise (through straightening of the larval body) to the Dorylinae.

This study, then, supports Wheeler's conclusion (see above) that the Cerapachyinae are intermediate between the Ponerinae and the Dorylinae and also tends to confirm his diagram (1920, p. 52) of the phylogenetic relationships of the subfamilies of Formicidae.

A Bibliography of the Larvae of the Cerapachyinae

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The Northernmost Extension of Bird Hippoboscidae in the New World (Diptera).—The Hippoboscidae are essentially a tropical and subtropical group of insects. In cold temperate regions the number of species is very small and most of them seem to occur only as accidental summer visitors. In the New World the 50th parallel forms about the northern limit for the family as a whole. Farther north the flies are probably not truly part of the autochthonous fauna. Among the many hundreds of North American flies I have seen in recent years, only half a dozen, all of one species, *Ornithomyia fringillina* Curtis, were taken in Alaska, at the following localities: Crater Mt., off "Columbia falcon"; Nelchina River, north of Mt. Witherspoon (N.W. of Valdez); Takotna, 63°N., 165°W., off Hudsonian spruce grouse, *Canachites c. canadensis* (Linnaeus); and Old Crow River, Timber Creek, Yukon. Takotna is the northernmost locality for a hippoboscid in the New World. In the eastern part of the continent these flies stay much farther south, the northernmost record there being an *Ornithomyia fringillina* taken by Eidmann off a junco on the Matamek River in the southern part of the Labrador Peninsula (50° 17′ N.). Hippoboscidae of birds seem to extend farther north in Europe, where several species occur in Finland. One of them (*O. fringillina*) has been reported also from Iceland. None are known from Greenland. Several of the common passerine birds, serving as hosts of *O. fringillina* in southern Canada and the United States, extend during the summer to the Arctic Circle and beyond, so that the virtual absence of hippoboscids from the far north is most probably due to adverse climatic conditions.—J. Bequaert, Museum of Comparative Zoology, Harvard University.

VESPID WASPS (*EUMENES CURVATA*) ATTRACTED TO SMOKE

By Charles T. Brues
Biological Laboratories, Harvard University

Smoke is not ordinarily attractive to insects, but certain flies of the family of Clythiidae have been noted by several entomologists to be strongly attracted by the smoke from burning weeds or even by chimney smoke. Kessel has recently published an account[1] of the American smoke flies which belong to the genus *Microsania*. The genus is represented by several species in Europe, two in North America, and others in Australia, New Zealand and equatorial Africa. From Kessel's account of his own observations made in California and his well documented summary of observations reported by others, it is evident that all the known species of *Microsania* throughout the world are irresistably attracted to smoke. Smoke from varied sources causes the flies to congregate, as the numerous observations relate to smouldering fires of vegetable debris, smouldering heath fires, forest fires, smouldering bonfires, and the dense smoke cloud from the chimney of a barbecue. Their occurrence on the tent of a camp in the woods is undoutedly a similar response to a camp-fire.

My own observations on the vespid wasp, *Eumenes curvata* Saussure,[2] were made in the Southern Philippines, near Dumaguete, on Negros Island. This is a common wasp in the locality, frequently building its clay nests attached to walls covered with shingles made of the leaf sheaths of abaca or on bamboo slats on porches and in rooms open to continuous access from without. The flying wasps were frequently noticed flying in the porch and adjoining room of a cottage where we were living, in the hills above Dumaguete at an elevation of about 1500 feet.

When we were smoking on the porch it was noted on many occasions that the wasps on the way back and forth to their nests hovered in lanes of drifting cigarette smoke. This is obviously very

[1]Kessel, E. M., American Smoke Flies. Wasmann Collector, vol. 7, pp. 23-30 (1947).

[2]This and the other identifications of Vespidae were kindly made by Dr. J. Bequaert.

attractive and quickly sensed by them, either by sight or odor from adjoining areas of clear air. Aside from certain small vespid wasps (*Ropalidia*) which nest in hollow bamboo railings, the large *Vespa tropica philippinensis* Sauss. which builds its carton nests under wide overhanging eaves, and certain itinerant scoliids in search of prey, this is the commonest wasp to be seen about houses. It is the only one which deliberately enters any zones of smoke that may be drifting about, as such fumes cause the others to dart quickly away when encountered during flight.

There can be no doubt that the Eumenes wasps, like the small Microsania flies are attracted by some material in smoke, quite possibly the creosote emanating from incompletely aërated fires.

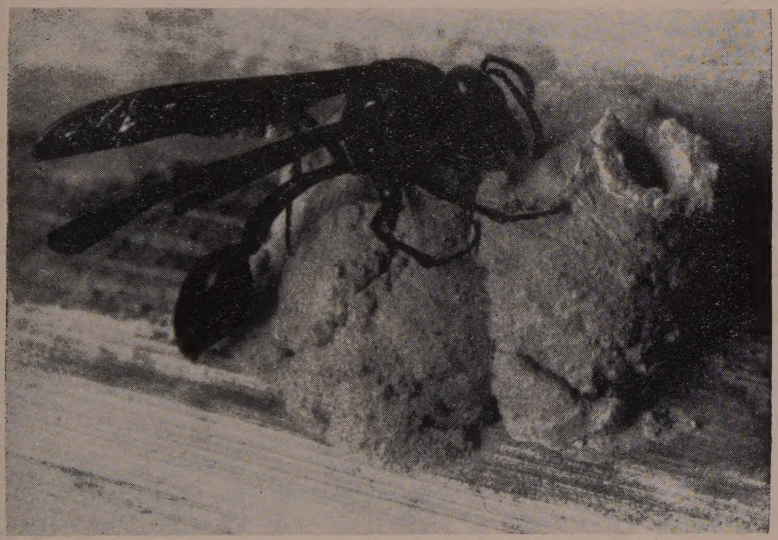

Fig. 1. *Eumenes curvata* Sauss. on nest; specimen now in the collection of the Museum of Comparative Zoology.

THE ALESSANDRO FOCARILE COLLECTION OF CARABIDAE (COLEOPTERA).—The main part of my collection of Carabidae (as of 1949) is now in the Museum of Comparative Zoology at Harvard College, Cambridge, Massachusetts, U.S.A. This museum now possesses the types, as listed below, of the ten species and subspecies of *Trechus* described by me in *Bollettino della Società Entomologica Italiana* Vol. LXXIX, 1949, pages 71-79. In some cases I did not select the actual "Tipi" (holotype and allotype) specimens from the type series at the time of description. In these cases I have asked Mr. P. J. Darlington to select and label appropriate specimens from the type series in question. His selections, listed below, I here designate as the holotypes and allotypes of the forms in question. The following types are now in the Museum of Comparative Zoology:

Trechus obtusus lucanus Focarile: original ♂ and ♀ (holo- and allo)types.

Trechus strigipennis valstronae Focarile: ♂ holotype and ♀ allotype from Lago Capezzone, selected by Mr. Darlington from the original type series.

Trechus schatzmayri Focarile: original ♂ and ♀ (holo- and allo)types.

Trechus marianii Focarile: ♂ holotype and ♀ allotype from Cima di Piazzo, selected by Mr. Darlington from the original type series.

Trechus brembanus Focarile: original ♂ (holo)type; and ♀ allotype from Mte. Ponteranica selected by Mr. Darlington from the original type series.

Trechus magistrettii Focarile: original ♂ (holo)type; and ♀ allotype from (Pizzo) Presolana selected by Mr. Darlington from the original type series.

Trechus barii Focarile: original ♂ and ♀ (holo- and allo)types.

Trechus barajoni Focarile: original ♂ and ♀ (holo- and allo)-types.

Trechus larianus Focarile: original ♂ (holo)type; and ♀ allotype from Passo di Sasso Canale selected from the original type series by Mr. Darlington.

Trechus maritimus pesianus Focarile: original ♂ and ♀ (holo- and allo)types.—ALESSANDRO FOCARILE, Milano, Italy.

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